1. *Exploring a multivariate dataset.* Descriptive statistics and graphical displays. The geometry of a multivariate sample. Sample mean, covariance and correlation. Generalized variance and total variance. The metric induced by the covariance matrix.

2. *Data representation and dimensional reduction.* The analysis of the covariance structure, principal component analysis (PCA). Independent component analysis (ICA).

3. *Discrimination, classification, clustering* Statistical classification: model, misclassification costs and prior probability. Bayesian supervised classification and the Fisher approach to discriminant analysis. Cross-validation for the evaluation of a classification function. Alternative approaches to classification: logistic regression, CART. Similarity measures. Unsupervised classification; hierarchical and nonhierarchical methods. K-means and K-medoids. Multidimensional scaling.

4. *Inference about mean vectors*: The multivariate normal distribution, the Wishart distribution, the F distribution. Hotelling T^2 test. Confidence regions and simultaneous comparisons of component means. The Bonferroni method for multiple comparisons. Familywise Error Rate and False Discovery Rate. Comparisons of several multivariate means. ANOVA and MANOVA. Inference for Linear Models. Beyond Ordinary Least Squares: ridge regression, lasso, regularized least Squares. The permutation approach to testing and its application to testing the centrality parameter of a multivariate distribution, ANOVA, MANOVA, repeated measures design.

5. *Introduction to Functional Data Analysis.* Data smoothing, dimensional reduction and representation. Functional principal component analysis. Data registration: phase and amplitude variability. Classification of functional data.

6. *Statistics for spatial data.* Random fields, variogram models and variogram fitting. Spatial prediction and Kriging, Functional data with spatial dependence.